

# SUPPLEMENT.

## The Mining Journal, RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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### THE IRON AND STEEL INSTITUTE.

The annual general meeting of members was held at Westminster Palace Hotel, on Wednesday.

Mr. I. LOTHIAN BELL in the chair.

There was a large attendance of members, and amongst those present were—Sir Wm. Fairbairn, Sir J. Alleyne, Mr. Lancaster, M.P., Lord F. Cavendish, M.P., Sir J. Whitworth, Mr. H. W. F. Bolekew, M.P., Mr. A. Brogden, M.P., Mr. J. Dodds, M.P., Mr. R. Fothergill, M.P., Mr. Menelaus, Mr. W. Fowler, Mr. Brown, and Mr. Nasmyth.

The CHAIRMAN was happy to be able to relieve them from any disappointment they might feel from his being called to the chair by stating that the absence of the Duke of Devonshire was merely temporary; he was at the London University to receive Her Majesty at the opening ceremony, and would, no doubt, be present amongst them almost before the formal business was disposed of. He concluded by calling upon the secretary to read the report of the council:—

In presenting the first report, the council think it desirable to record briefly the history of the Iron and Steel Institute. The proposal for the establishment of the society was submitted to a meeting of the Northern Iron Trade, held at Newcastle-on-Tyne, Sept. 29, 1868. The suggestion was approved, and a provisional committee, including representatives of each iron-making district, was at once nominated. This committee adopted means for canvassing the leading members of the iron and steel trades, and the result was that by the beginning of 1869 the number of gentlemen willing to become members was sufficient to justify the formal establishment of a technical institute for the iron, steel, and allied trades. There has been a steady accession of members since the society was established. At the end of December the Institute numbered 292 members, and a considerable addition will be made to the list at this general meeting. It was originally intended to hold four general meetings of members in each year—two in London, and two in the provinces; but the council wish now to propose that the number of general meetings be reduced to two, and that the proceedings on each occasion extend over several days. A modification in the rules embodying this change will be submitted, together with several minor alterations, the object of which will be to reduce the number of meetings to two. The council will also bring forward a few other alterations in the rules, which they suggest should be made, in order to remedy some defects found to exist with respect to the election of members of the council. During the current year it is proposed to hold two meetings—the present annual meeting, and a provincial one in September. A cordial invitation has been received from members of the Iron Trade of South Wales, and the council recommend that this invitation should be accepted. With a view to render the Transactions of the Institute more useful to the members, the council propose that they shall be issued in the form of a Quarterly Journal, and that, in addition to full particulars of the society's proceedings, each number shall contain an abstract of scientific memoirs, publications, papers or discussions bearing upon the iron or steel trades, which appear in the home or foreign journals. They propose, also, that members should be invited to contribute short notices of matters relating to the metallurgy of iron or steel, but which may not be of sufficient importance to form a communication for discussion at the general meeting.

The council have had under their consideration the desirability of appointing a committee to report upon the question of mechanical puddling. They believe that very great service would be done to the trade in general if a few practical members who can devote some time to the investigation would undertake to report upon this important subject, and they accordingly recommend that such a committee be forthwith appointed, and that a reasonable sum be placed at their disposal for the purpose of the enquiry. The council have also had under their consideration the feasibility of taking some steps for obtaining a more comprehensive and reliable record than now exists of the character and distribution of the iron ores of Great Britain and Ireland. They have placed themselves in communication with the Geological Survey, and have requested that the publication of the Analyses of Iron Ores, commenced several years ago, might be completed. Also that the officers of the Survey might be allowed to report more fully upon the distribution of hematite and other iron ores in those parts of the country which were surveyed before so much interest attached to the existence of the purer classes of iron ores. The Survey was, however, unable to entertain the request of the council. As the latter believe it to be a matter of importance to the iron and steel trades that the analyses of our native iron ores should be completed in an authoritative manner, and that more precise and reliable information than is at present available should be obtained relative to the distribution of iron ores in this country, the council recommend that a committee be appointed, and requested to furnish a report upon this subject at their early convenience. The council have given some attention to house accommodation for the Institute. They have not done anything in this matter at present, however, because they have been unable to determine even approximately what would be required by the society. But books, periodicals, &c., are being rapidly accumulated, and the subject of house accommodation in London is becoming more pressing. Under these circumstances the council have been glad to notice a movement for the erection of a block of buildings which should be sufficient for the purposes of a number of scientific societies. They would recommend that the Institute should support this movement, and if eventually found practicable should endeavour to make arrangements for obtaining accommodation in the proposed buildings. The accounts to be presented by the treasurer include the expenses connected with the establishment of the Institute, and are for the 15 months ending Dec. 31.

The adoption of the report was proposed by the CHAIRMAN, seconded by Mr. FOTHERGILL, M.P., and carried unanimously.

Mr. DALE, the treasurer, then read his financial statement for the year, and observed that they would see that their income had exceeded their ordinary expenses by about 1000; the fact of there being 377, due to the treasurer, arising from the extraordinary expenses connected with the establishment of the Institute.

Mr. E. WILLIAMS moved, and Mr. J. DODDS, M.P., seconded the reception of the treasurer's report, and the motion having been put to the meeting, was carried unanimously.

Sir JOHN ALLEYNE had pleasure in moving the appointment of a committee to investigate the subject of mechanical puddling, and he did not think they could possibly place the matter in better hands than those of Mr. Menelaus, Mr. Kitson, Mr. I. Lothian Bell, Mr. Fowler, and Mr. Williams.

Mr. FOWLER did not think a more important subject could occupy the attention of the Institute, and, therefore, willingly seconded Sir John Alleyne's motion, whose name would, of course, be added to the committee. The subject was not only important, from the actual advantage to be derived, but from the increasing difficulty of dealing with puddlers. His firm had six double furnaces for mechanical puddling at work. They had had great difficulty in dealing with the men, and also in dealing with mechanical puddling, but the latter they had now entirely overcome, and for some time past they had made 26½ tons per week, on the average, with each furnace. The loss was 11·23 per cent., and the coal used was 19 cwt. per ton of pig-iron. Mechanical puddling entirely removed the wages difficulty. At the six furnaces they only required 12 puddlers. Each puddler had two underhands, one at 5s. per day, and the other at 4s. 6d. per day, and one of them had 3s. 6d. per week extra for getting up the furnace. Each puddler receives 11s. and a fraction per day. They work five heats per day, and 12 cwt. to the heat. The iron they puddle is charcoal No. 2 cold-blast, and Swedish and likewise steel-iron. At first they puddled 9 cwt., but they had now increased it to 12 cwt., and he believed there would be no difficulty mechanically in puddling 1 ton, but there would be inconvenience from the rapid oxidation.

The CHAIRMAN thought that a case had been made out for the appointment of the committee, and upon the motion being put to the meeting it was carried unanimously.

Mr. JOHN LANCASTER, M.P., then moved that Messrs. Dale, Wood-

house, Smith, and Bell be appointed a committee to report on the distribution of iron throughout Great Britain and Ireland. He believed it would be of importance for this committee to collect all that had been done in this direction.

Mr. SMITH hoped that too much would not be expected from this committee; it was to be simply a preliminary committee to make a preliminary report, but one which he hoped would be made more extensive when the Institute was more developed.

Messrs. Whitwell and Head were appointed scrutineers to open voting papers, and upon their stating the result of their scrutiny, it was found that the number of members had been augmented to 350.

Mr. J. JONES (the secretary) read the amendments in the rules, proposed to carrying out the recommendations of the council, and they were unanimously agreed to.

Mr. FOTHERGILL, M.P., said it gave him much pleasure to learn that they had decided to hold their next meeting in South Wales; he offered them a cordial invitation, he could assure them that they would receive a hearty welcome, and that his friends would not forget the reception they had had in the North of England. They must not, however, expect to see too much that was striking; they were an old working community, and their principle consisted in aiming at economy, rather than at enterprise.

Mr. CRAWSHAY seconded the invitation, and the meeting accepted it with acclamation.

The CHAIRMAN then called for remarks on the paper, "On Improved Machinery for Rolling Rails," read at the previous meeting by Mr. Menelaus.

Mr. WILLIAMS thought the improvements introduced in connection with iron works were likely to prove of much advantage. He believed that much would be done by machinery that is now done by manual labour. He knew nothing that could better be done by machinery than the moving about of the iron in the mill. As the masses which have to be moved in a rail-mill are usually receivable at a fixed point, and to be moved to another fixed point, the difficulty was comparatively small. Of course, there were difficulties in moving hot materials which did not exist with cold, but these were so trifling that he hoped to do all by machinery. In connection with the application of the system of roll before roll, he would take the opportunity of asking Mr. Menelaus whether the rail-mill which was being erected in France with five-pairs roll before roll had been carried out?

Mr. FOTHERGILL had seen the Dowlais mill in operation, although it was under a disadvantage, for the iron had to be brought out before it was perfectly hot. But this enabled him to see the great merit of the mill, for iron imperfectly heated was rolled into a perfect rail. An excellent rail was made with iron at a heat that he would scarcely have ventured to touch it in the ordinary way of rolling. He would like to learn whether Mr. Menelaus still approved of the principle, and whether he was right in supposing that Mr. Menelaus was of opinion that it produced a more homogeneous rail? There was now a plan of rolling with two pairs of rolls backwards and forwards, and he would also like to hear Mr. Menelaus's opinion as to the value of that plan.

Mr. MENELAUS thought the mill in France was not started, but shortly would be. In rolling the French had great advantage over us; they have much larger orders, and, therefore, had not to change the rolls so frequently. He thought it would not be well in Wales to have more than three pairs roll before roll. In reply to Mr. Fothergill, he did not claim to make better material by the Dowlais mode of rolling, but there was a saving of labour—they saved 6½d. per ton. But though he did not claim any improvement in materials, they made no cobbles, either in blooming or roughing, which was a great advantage. As to Mr. Brown's system of rolling, he scarcely liked to speak of it, as his object was to do the same as he did in the Dowlais rolls. In Mr. Brown's system of rolling rails the iron passes through blanks on one pair of rolls, and grooves on the other pair. The consequence was that you must have twice the length of roll with Mr. Brown's system. He thought that in the Dowlais rolls they had long previously got over that difficulty, by placing the back rolls a little higher than the front ones, so that they were enabled to occupy the whole length.

Mr. BROWN denied that the rolls were twice the length; they were the same length exactly.

Mr. MENELAUS admitted it, but they only do half the work. What he objected to was that Mr. Brown doubled the stock of rolls for each section. The cost of raising the point of the iron at Dowlais was, he contended, less than the value of the space occupied by blanks in Mr. Brown's rolls. The disadvantage even of the Dowlais was that you had two pairs of rollers to change instead of one whenever you changed the section. There were probably some cases, as for example when they had large quantities to roll of regular section, but he objected to it for the rolling of rails.

Mr. FOWLER said that both in the Dowlais rolls and in the system adopted by Mr. Ramsbottom, of Crewe, useful work was got for the whole length of roll. But what was the advantage of doing away with the reversing?

Mr. MENELAUS thought the advantage was very considerable. He sought to get the advantage of high speed, and with reversing 40 revolutions a minute was as much as they could get. He tried to get 100 revolutions with the advantage of reversing. He thought you could not do that even with the friction surface system. As to the advantage of avoiding the reversing of the rolls, he thought that both with Mr. Brown's and the Dowlais system it would be found that there was a great saving at the end of the year.

Mr. B. WALKER had seen the application of the friction-surface system, invented by Mr. Kitson. The mill worked well, and it would, no doubt, go on for years. They could readily reverse at 60 revolutions. There was no cross strain whatever, they had simply a steam cylinder, acting on a small ram. The traverse of the friction-band is only ½ in. The reversing could be effected close to the roller, and the cost of the rolls was not much more than at present. As to reversing generally, he would say that if you took off the fly-wheel you would have no difficulty in reversing at 40. They put two trains one a little before the other, and make the first go a little slower.

Mr. WILLIAMS thought that if Mr. Menelaus had to erect another mill at Dowlais there would be no necessity for alteration. As to girders, he did not see that roll before roll would do for girders at all. It was always better not to move things sideways at all, for they must remember that the metal was as pliable as a ribbon. They had two sets of rolls, running 100 revolutions, and did not waste an inch of roll length. He would like to ask Mr. Brown whether bolts could be rolled in roll before roll?

Mr. C. W. SIEMENS, F.R.S., believed that the most preferable plan, if we must reverse the rolls, was to reverse them with the engine. Whenever you have clutches you must have jerks, but if you reverse the engine itself you will have no jerks whatever. The system of reversing the engine with the rolls was, in his opinion, very perfect, especially for heavy work.

Mr. COWPER agreed with Mr. Siemens. He remarked that it was Mr. James Nasmyth who suggested the removal of the fly-wheel.

Mr. B. WALKER suggested that if it were bad to reverse the rolls it must necessarily be worse to reverse the whole of the machinery. There was another very great objection, that if you reversed the engine you could not drive two mills from one engine.

Mr. JAMES NASMYTH said that he dispensed with the fly-wheel, and reversed with the link motion, because he was always convinced that the fly-wheel was a nuisance. If they had a good cushion of steam for their spring they would have no jerks. They had no shock with the heaviest steam-hammer, although in that case they had a large mass of metal suspended most freely.

The CHAIRMAN observed that the next paper for discussion was "On the Generation of Combustible Gases under Pressure."

Mr. SIEMENS was in favour of putting fuel into gas before it is used, as you could then purify and heat it before you burn it. You thus get rid of a great inconvenience, and can obtain a higher degree of heat without drafts. He considered the mode of generating should be as simple as it could be, and he had endeavoured to render it as simple as he could conceive. He thought the apparatus before them at the last meeting appeared to be a little complicated.

Mr. FOTHERGILL enquired whether he was right in understanding that in the case of combustion under pressure they got increased heat?—Mr. SIEMENS said that if we compress the air one atmosphere that raised its temperature about 210° Fahr.; a gas producer, however, should work at a minimum rather than at a maximum temperature.

Mr. BENSON thought that he had stated in his paper that it was only after having seen Mr. Siemens's furnace that he designed his as an improvement upon it. When he commenced experimenting he found that he could not work at a high pressure; he had since ascertained that by his improvement you could use not only non-caking coal, but caking coal also. The pressure in this generator is only enough for the pressure in the furnace.

The paper "On a Fire-Brick Hot-Blast Stove," by Mr. Thomas Whitwell, was next discussed.

Mr. WHITWELL would say, with reference to the paper, that they had got the figures for fuel down to 17½ cwt., as compared with 18 cwt., as stated in the paper. They had made 401 tons per week, and turned out 85 per cent. grey forge, and only 2 per cent. white iron. The Duke of DEVONSHIRE now entered, and took the chair.

Mr. I. L. BELL said that there was no question of greater importance than that before them, for every hundredweight of coke saved in making a ton of pig-iron represented 500,000 tons of coal saved per annum. He thought Mr. Whitwell had drawn inferences which the facts did not justify. He explained the theory of the smelting process, and observed that for the carbonic oxide from the fuel to absorb the oxygen from the ore required a certain time. He contended that experience had proved that no additional advantage resulted from exposing the ore beyond a certain time, and questioned whether, if time gave no advantage, increased temperature beyond a certain limit would be beneficial. He thought all was explained by assuming there was a point of saturation at which carbonic oxide ceased to absorb oxygen from the ore, but at which, on the contrary, the carbonic acid formed commenced to give up its oxygen to the reduced iron, forming, as it were, a factitious iron ore and carbonic oxide. The great question with regard to Mr. Whitwell's stove was—Can you, with a small furnace and high temperature, do the same as with a large furnace and a low temperature? He questioned this, owing to the decomposing influence of carbonic acid being greater than the deoxidising influence of carbonic oxide. As to economy, he calculated that whilst the Whitwell stove cost 1500% per furnace, the additional cost of their large furnaces was about 1400%, each, so that the difference was unimportant.

Mr. WILLIAMS had arrived at the same conclusion. After a certain size, about 12,000 ft., they got more make, but there was no diminution of fuel per ton of metal. At Whitton they were building a new cast-iron hot-blast stove, which would have such an arrangement of valves that the temperature could not be got up to the melting point of iron. He considered that after 12,000 ft. capacity, and after 1000° Fahr. temperature, there was no saving in fuel per ton of iron.

Sir Wm. FAIRBAIRN had been gratified at being present, for he thought the result of the Institute's proceedings would be to reduce the cost of iron and steel. If the Institute could do this, it would have the effect of preventing the introduction of foreign iron. Thirty years ago they were just commencing the use of hot-blast iron, and they found that there was no great difference in quality, although the price of the hot-blast iron was much less. From the introduction of steel, equally important improvements were to be anticipated.

Mr. COCHRANE refuted Mr. Bell's theory with a few simple facts. By increasing the size of their furnaces they had reduced the consumption of fuel 4 cwt. per ton of iron; and as to temperature, at 1000° they had used 24 cwt., and at 1422° they had reduced it to 20 cwt., so that they showed distinctly that there was an economy of 4 cwt. due to temperature and of 4 cwt. due to capacity. There was no doubt, as Mr. Bell had stated, that they did work with 150° fluctuation, but with that they got a uniform quality of iron. In a small stove they had even had a fluctuation of temperature of 250°, and still had no fluctuation in the quality of the iron produced.

Mr. CHARLES M. PALMER then read a paper "On Iron as a Material for Shipbuilding, and its Influence on the Commerce and Armament of Nations." Fairbairn in a work on iron shipbuilding had pointed out the superior advantages which wrought-iron possessed over all other materials for shipbuilding. The iron plates of a vessel could be so rivetted together that the joints would sustain a breaking strain equal, in double-rivetted joints, to 70 per cent., and in single rivetted joints to 56 per cent. of the breaking strain of the solid plate, and this after taking into account part of the plate punched or drilled out in making the joints. It was also set forth as the result of, and deduced from, experiments that if the skin of a vessel could be made of wood 6 in. thick, without joints, that it would be equal to iron plating rivetted together of 1½ in. in thickness. This proportion was established on a comparison of the tensile strengths of the two materials, but so far superior were the facilities for the uniting of different pieces of iron to those of combining wood, that the 1½ plating would be 134 times stronger than the wood sheathing combined in the ordinary manner used in wood shipbuilding. It was so difficult to fasten the wooden skin of a vessel that the combination was only 1·134th part of the tensile strength of the material. Iron ships weighed 33 per cent. less than the

timber vessel, while the displacement of water was the same—greater strength was attainable, higher sailing qualities secured, and less strain liable in iron-built ships. The number of voyages made by iron screw colliers to and from London had risen from 17 in 1852 to 2440 in 1869, while the tonnage carried in the same period had risen from 9483 to 1,718,563. Taking the tonnage of British vessels built, he found that of timber there were in 1850 vessels carrying 120,895 tons, and 12,500 tons in iron vessels, while in 1868 the proportion was reversed. In that year the tonnage of timber-built vessels was 161,742, and iron-built vessels reached 208,101. The same marvellous increase of iron vessels over wooden was also seen in the amount of steamers constructed. In 1850 the gross tonnage of wood steam vessels was 217,829, while that of iron was only 57,361; but in 1868 the tonnage of wood vessels was only 122,282, while that of iron vessels had risen to 1,341,106. America had not advanced iron shipbuilding, because labour was dear, and the manufacture of iron was a costly process. France had made no perceptible progress in adapting her mercantile marine to modern requirements. In England they had, amongst the vessels comprising the British navy, vessels of 130,150 tonnage, and 9400 tonnage of a composite character. Shipbuilding in Holland was altogether on the decline. The Norway shipbuilding was entirely confined to timber vessels; while respecting Italy, commerce was mostly carried on by English steamers. He was of opinion that the position already attained by England would enable her to keep a foremost place in commerce for some time to come. He would not, in conclusion, dilate upon the beneficial effects of the development of iron steam navigation upon civilisation and the peace of nations. We have in a great measure substituted iron for wood, we must now change iron for steel, and he suggested the desirability of devising methods of cheapening and rendering practicable the use of steel in ship construction.

Mr. DIXON observed that the question of the fouling of iron ships was of great importance, and that the increase in the use of iron would be great if this could be remedied. It must be remembered amongst the advantages resulting from the introduction of iron that iron had been used for inland navigation in positions where wood would be inapplicable.

Mr. JOHN GRANTHAM bore testimony to the truths of Mr. Palmer's paper. As to the question of fouling, the speed of the Warrior would be reduced to one-half if she were only for a short time on a foreign station. Twenty years ago he patented the coppering of iron vessels, and its importance was now recognised. Mr. Reed had made a mistake in bolting on his planks with some 30,000 bolts; the bolts become eaten away. He considered the substitution of steel for iron would reduce the weight of the vessel by one-third.

Mr. PALMER, in reply, remarked that when the first iron collier was designed and built of 550 tons burthen, it was said to be too large, as that quantity of coal could not be dealt with in the London market. Now vessels of 1000 and 1500 tons were a common size, and the loading and discharging of them offered no inconvenience.

The SECRETARY then read the heads of Mr. Gillott's paper "On Designing Rails," in order that it might be printed in the Transactions and discussed at the next meeting. The proceedings then terminated.

In the evening a conversation was held, at which most of those present at the meeting attended. Some good specimens of metal were exhibited, and a few interesting models. A modification of Ormerod's catch, already well known to the readers of the *Mining Journal*, for the prevention of over-winding, was exhibited by Mr. John King, of Pinxton, Derbyshire; and Mr. Wm. Yates, of Duke-street, Westminster, exhibited an ingenious self-extinguishing safety-lamp, the invention of Mr. J. A. Hogg and himself. The chief recommendation of the lamp is its great illuminating power, obtained by the introduction of an ordinary bull's-eye lens into the gauze opposite the flame, which has a small reflector behind it. It is claimed that it consumes 20 per cent. less oil, and gives 30 per cent. more light.

#### SOUTH WALES INSTITUTE OF ENGINEERS.

##### THE COMPARATIVE MERITS OF LARGE AND SMALL TRAMS FOR COLLIERY USE.

The discussion on Mr. J. Brogden's paper was resumed.

A GENTLEMAN formerly connected with a colliery in the Aberdare Valley gave some interesting particulars of his own experience, which he prefaced by remarking that in looking over former discussions the first thing that had struck him was the necessity for a definition of "large" and "small" trams. The dimensions of the tram which he had experimented with was as follows:—Length, 3 ft. 6 in., inside measure; breadth, 3 ft. 1 in.; depth, 1 ft. 6 in.; size of wheels, 9½ in.; distance between wheels, 1 ft. 5 in.; width of gauge, 2 ft. 2 in.; and the trams he was now working were exactly the same, except that the gauge was 1 ft. 9 in. The weight of the tram was, in round numbers, 3 cwt.; he had weighed one on Monday, and found it was 2½ cwt. and 14 lbs. It carried 8 cwt. The axle was of round iron, and its diameter 1½ in. The frame was of oak, 4 in. by 2½ in.; cross bars, 3 in. by 1½ in.; the bolsters, or what carried the axles (oak), 5½ in. by 2½ in.; the boards at the bottom (elm), 1 in.; sides and ends, ½ in.; angle (iron), 1½ in. by ½ in.; bolts, ½ in. by 5 and 5-16ths; the weight of wheel and axle for one tram, 115 lbs., and weight of pedestal 21 lbs.—cubical inches, 27,792. With these trams horses had nothing whatever to do, except on the main roads. Boys ran them about the roads wherever they had to go. At the colliery spoken of all the cross-headings were self-acting inclines; the horses only went on the level roads—neither did they where he was working at present. The cross-headings were driven in the first instance with small trams at 3s. 4d. per yard instead of 5s. 10d. with a large tram and horses, for double turns; 3s., instead of 5s. 6d. for single turns—making a difference of 2s. 6d. in the cross-headings. In the level headings, and with ponies, the price was the same. Not having to take the horses into the stalls, they saved 2 ft. of blowing the top in the stalls. The top and bottom were very hard, and in consideration of saving the blowing of 2 ft. of top, instead of the horse going into the stall, the collier or his boy brought the trams to the top of the incline, where the pony was in waiting. The agreement they made with the colliers was that they (the colliers) would thus run the trams a distance of 70 yards instead of blowing 2 ft. of top, so that all the pony or horse work in going to each man and fetching a single tram was saved by the boys bringing the tram to the top of the incline. They had, therefore, not only a saving of 2s. 6d. a yard in cutting, but a great saving in pony work. At the time spoken of the colliery was raising 150 tons a day. There were three inclines, of 320 yards each in length. There were four ponies, and the cost per day, four ponies and incline, raising 150 tons, was 12. 12s. The next saving was that, because they blew no top down in the stalls, neither did they in the cross-headings, there was more than ample room for the rubbish, for very little was made. They had not sufficient to gob one-half of the workings; and they did not bring out a single tram of rubbish from the colliery except there were a fall, and that fall were between an open working and the pit. If the fall were beyond the open working it was taken into the stalls. Beyond that there was not a single tram of rubbish brought out of the pit of 2 ft. 8 inches. There was also a saving of labour in the taking of the rubbish to the different parts of the colliery; and they had not a single man and horse in the pit at night to prepare for the next day's working. All this had resulted from the adoption of the small trams. The next saving was as to the hauling. At the time he spoke of, he believed that throughout the Aberdare Valley the wages of the haulers were 3s. 4d. a day. They had also a boy with each pony or horse, at 8s. a-week, making 5s. for the driver. He had reduced that by the small tram to 2s. 3d.—with this difference, that the boys who now went with the horses had to open and shut the doors as they went along, whereas previously they had a boy to each door, and they had to keep the same number of boys that they had doors in the pit. Therefore they had a saving of half the hauler's wages, independently of the saving of hauling rubbish in the different parts of the pit, and the blowing of the top. Moreover, they saved the "dusters." He might add that he had now ponies working the trams he had described, and bringing 15 to 20 trams each journey; and with a main road of 1900 yards, and sending the trams down an incline of 200 yards, the cost of boys, haulers, and all that, did not exceed 4d. a ton. There was one remark as to the men and boys. If two men were working, the one who was chiefly occupied in filling the coal claimed the same wages—(say) 5s. a day—as the cutter of coal. But with the small trams a boy could fill the coal at 2s. or 2s. 3d. a day, and the collier could earn 10s. or 12s. a day. The speaker argued, therefore, that the small tram was advantageous both to the collier and to the colliery proprietor. Then as to the quantity of small coal made, he found no difference between large and small trams—or rather, in his experience, the percentage was in favour of small trams. All the facts having been enquired into and fully ascertained, the owner of the colliery in question was satisfied that

not only was there a saving with small trams of 1s., but of 1s. 3d. a ton, as was shown by the cost-sheets—in fact, the owner gave instructions that the small trams should be applied throughout the whole of the colliery. He (the speaker), however, reasoned against that proposition, because the collieries were carried to such a distance that the change would be too expensive to be remunerative; but he advocated the adoption of small trams in all new collieries. In answer to a series of questions, the speaker said he knew that the Aberdare Valley included veins of 4 feet, 6 feet, and 9 feet. He would recommend small trams in all veins that he was acquainted with; and in fact he would recommend them in all instances, even were the vein 21 feet; because (he was a Lancashire man) they had small trams whatever the thickness. In the pit referred to the arrangements were such that the stalls and cross headings were self-acting inclines. The angle of inclination was 1 in 12—about 3 in. to the yard.—A Member enquired whether the comparison had been made between the whole of pit No. 1 and the whole of pit No. 2, or only between the two 6 foot veins?—The Speaker replied that the question had been gone into thoroughly—not only as to the difference in the price between the two 6 ft., but between the 6 ft. in No. 2 with small, and the 4 ft. in No. 1 pit with large trams. The difference in the latter case was more than they could have imagined. But there was an allowance to be made, because in the 4 feet in the particular pit in question there was a great deal of small, which caused the expense to run up, so that they had come to the conclusion that to strike a balance between the 4 ft. and the 6 ft. would, under the circumstances, be unfair, inasmuch as the benefit of the small tram was shown to a greater extent than by the comparison in the two 6 ft. veins. But the owner was convinced that the adoption of small trams throughout the colliery would be advantageous. There was little difference in the lead—in the distance of the transit of the coal. The small tram was filled to the level—there was no piling whatever.

Mr. BROGDE (the Government Inspector), without entering into the merits of either large or small trams, drew attention to the large sacrifice of life among young people in shifting about large ponderous iron trams. It was not for him to say that all which had been stated could be effected by small trams. They knew that in many of the Welsh collieries they had hard, strong coal, and it was necessary for the market that it should be of considerable size. (Hear, hear.) Moreover, by throwing ponderous lumps of coal of 2 cwt., or more into a wooden tub, they would in a few weeks break the tub to pieces. But he was not desirous of entering into any argument as to which tub was the best—in every country men adopted what they found to be the most suitable. He merely made the observation which a Government Inspector would naturally make to his brother mining engineers, that the number of deaths brought about by large trams was a melancholy record, and the distress and misery to the horses was great.—The first Speaker remarked that in his small trams, lumps of 6 cwt. each were brought out. They were wooden trams. He knew collieries using the same cubical dimensions of tubs, raising nearly 4000 tons a-day, and not a single boy had been crippled by the trams. He thought Mr. Brogden's statement would be borne out as to accidents. In answer to a question, the speaker stated that he had a "billy" with the small trams and with the large. As to the winding apparatus, if he had a pit of any great depth, as pits were now made, he should have a double or treble-decker carriage. In the saving of a shilling a ton with small trams, they had not estimated the saving in pit-wood.—Several members expressed a doubt that the speaker had been mistaken in the figures he had adduced, but that gentleman said he had seen the cost-sheets in London that week, and they, if produced, would fully bear out all he had said.

The MANAGER of a COLLIERY in the Aberdare Valley said he had been using the small trams for years; the men were greatly prejudiced against them; he could not by their use save a penny a day as compared with large trams; and he believed that the men would submit to a reduction of 2d. a ton if they might return to the large trams. In a colliery of his own in the Aberdare Valley he would not use small trams, but where the coal was filled "through and through" he would adopt them.

The WRITER of the PAPER said so far as he had been led to any conclusion by the discussion he was confirmed in his view in favour of the small trams. They had found in the substitution of the small for the large trams no difference as to the tare of the tram; nor as to the quantity of large coal raised did they find any advantage in the large trams. Neither did they experience any prejudice on the part of the men except as to this—that he believed they would have a strike if they attempted to re-introduce the large trams. Of course his experience differed on that point from the experience of a previous speaker; he could only say the difference was very wide. He would only add that he hoped in a short time to make a change from the large to the small tram in an important colliery, and he believed the change would result in a saving. At his colliery they filled "through and through," but he conceived that made no difference.

The discussion was then closed, a vote of thanks being given to Mr. Brogden for his able paper, which, it was remarked, had both itself conveyed and had elicited much valuable information.

##### BERARD'S COAL-WASHING MACHINE.

The adjourned discussion on Mr. Windsor Richard's paper on this machine was then taken, but in the absence of the writer very little was said.

A MEMBER asked for further details of the items of cost, which he thought the writer might advantageously furnish at a future meeting; another gentleman stated in reply that he had found that with Berard's Washing Machine on 2000 tons of coal the cost was 3½d. a ton for washing.

The discussion was then adjourned.

The discussion of Mr. Allison's paper "On the Cleveland Ironstone" (already published), and Mr. E. Williams's paper "On the Blast-Furnaces at the Cleveland Iron Works," was also postponed.

##### THE APPLICATION OF BLAST OF A HIGH TEMPERATURE TO BLAST-FURNACE OF MODERATE ELEVATION.

The EDITING SECRETARY read a paper on the above-named subject, written by Mr. Thomas Whitwell. As, according to the rules of the Institute, the papers are not allowed to be published until they appear in the "Proceedings" of the Institute, the insertion of the paper in our columns is, therefore, deferred.

Mr. WHITWELL offered a few explanatory remarks, and the discussion was adjourned to the next meeting.

A paper "On Mining Schools," by Mr. Thomas Coomber, was taken as read, and will be discussed at a future meeting.

THE ELECTRIC FULGURATOR.—The Plymouth Institution and Devon and Cornwall Natural History Society held their annual Conversation at the Athenaeum on Monday, when the company were interested by a display of the marvellous effects of a new electrical apparatus of enormous power, devised by Mr. J. N. HEARDER, F.C.S., and constructed by him expressly for a scientific amateur, who had kindly permitted him to exhibit it to the society that evening. This extraordinary apparatus, to which Mr. Hearder has given the name of Electric Fulgurator, has for its objects the production of electric sparks or discharges of static or frictional electricity of immense length precisely resembling lightning flashes. By this arrangement prodigious sparks of great length are obtained, resembling zig-zag flashes of lightning, accompanied by a loud report. The apparatus, consisting of thirteen Leyden jars, gave sparks in free air of 3 feet 6 in. in length, very thick and crooked, and of a brilliant bluish-white colour. The deflagrating power of the apparatus, as exhibited in the combustion of metal leaves and wires, appears to be greater in the intensity than in the quantity of arrangement. When this discharge is made to pass through heated air its length is amazingly increased. Sixty-three small spirit lamps, each having two wicks, were arranged in a long double trough, so as to form a line of 126 spirit flames, extending to the length of 9 feet. Over these flames a brilliant spark passed with such facility from a moderate charge that Mr. Hearder calculated that a full charge would be able to pass more than double the distance. When the charge was a little reduced the sparks still passed through the flames in a less brilliant form, but producing a bright spot immediately over the top of each wick, giving to the whole the appearance of a long string of brilliant beads. Mr. Hearder stated that, although this apparatus originated with him, it was not new as regards date, for he had shown the society a similar arrange-

ment, though on a very much smaller scale, more than 40 years ago. Its present more imposing form was entirely due to the zeal and liberality of the gentleman before-mentioned, who, being desirous of ascertaining to what extent the principle admitted of development, had given him an order to construct the apparatus now before the society. The conclusions arrived at were, that with suitable arrangement might be almost indefinitely extended, and that sparks of 15 or 20 feet in length in free air would be by no means difficult of attainment. The present apparatus originally consisted of 15 jars, which gave sparks 5 feet in free air. In conclusion, Mr. Hearder remarked that this apparatus opened a new field for electrical investigation in connection with the effects of quantity and intensity in relation to static electricity, a subject never yet attempted for want of suitable apparatus, and he was bound to say that the results of the few experiments he had been able to make are such as could hardly have been predicted with our present notions of the action of the Leyden jar.—*Western Daily Mercury.*

#### ON THE STRENGTH OF IRON AND STEEL, AND ON THE DESIGN OF PARTS OF STRUCTURES WHICH CONSIST OF THOSE MATERIALS.

BY MR. GEORGE BERKLEY, M.INST. C.E.\*

The author stated that the strength of wrought-iron varied with the quantities of work involved in the production of the form of the material tested. This was proved by the fact that a bar of iron 1 in. square, which would break with a strain of 26 tons, would, if drawn down to the form of wire 1-32d in. in diameter, bear a strain of 40 tons per square inch. The strength to be relied on in practice would probably be best represented by the minimum strain that 1 square inch would bear without rupture, and by the amount of stretch which would take place in a given length before it broke. Iron could be obtained, at the current market rates, which would bear the following strains:—For plates, an average breaking strain of 20 tons per square inch, and a minimum breaking strain of 19 tons per square inch, and an average stretch of 1 in. in 12 in. lineal. For L and T irons an average breaking strain of 22 tons per square inch, and a minimum breaking strain of 21 tons per square inch, and an average stretch of 1½ in. in 12 in. lineal. For rivet-iron an average breaking strain of 18 tons per circular inch. For bars intended for chains, couplings, &c., an average breaking strain of 22 tons per square inch, and an average stretch of 1½ in. in 12 in. lineal. For ordinary classes of work, let competitive prices, stronger iron could only be obtained with difficulty.

In the consideration of the practical limit of strain to which 1 in. square of wrought-iron could with safety be subjected, and the principle on which such a limitation rested, the erroneous impression, as to the degree of strain being 10 tons or 12 tons per square inch which first produced "permanent set," was pointed out, as well as the apparent discrepancy between the results of ordinary observation and of minutely manipulated experiments, such as those of Sir William Fairbairn and Mr. E. Clark, was noticed, wherein permanent set had been observed after 3 tons per square inch had been imposed on the iron, and was explained by the difficulty of registering such small amounts of set as 0.1250th part of an inch in 5 ft., which resulted from a strain of 10 tons per square inch.

Attention was drawn to the fact that upon the application to 1 square inch of wrought-iron of strains exceeding about 12 tons, the measure of stretch per unit of strain, which had previously increased in a certain proportion to the units of strain applied, increased with a greater and progressive rapidity. It was also noted that the amount of stretch actually produced by the imposition of a strain of about 12 tons per square inch would be sufficient frequently to preclude the use of wrought-iron so strained.

In illustration of the effect of the repetition of strains on iron and steel, it was stated that with blows powerful enough to bend bars of cast-iron through one-half of their ultimate deflection (that was to say, the deflection which corresponded to their fracture by dead pressure) no bar was able to stand 4000 of such blows in succession; and, also, that when the bar was thrown into a violent tremor, then "when the depressions were equal to one-half of the ultimate deflection, the bars were broken by less than 900 depressions." A piece of rail, weighing 68 lbs. per yard, made of Bessemer metal, which, when placed on firm bearings 3 ft. apart, bore one blow from a weight of 1 ton falling through 30 ft. without breaking, though bending about 7 in., broke with a weight of 3½ cwt., falling 15,400 times through heights increasing from 1 ft. to 10 ft. by increments of 6 in. each time. With wrought-iron, it appeared from an experiment of Sir Wm. Fairbairn that when it was desired to repeat the application of strains from 2,000,000 to 3,000,000 times it would not be prudent that such strains should exceed 7 tons per square inch of section.

It appeared from these considerations that the practical strength of wrought-iron in structures of a permanent character could not be estimated at more than 12 tons per square inch when such an amount of strain was repeated more than a small number of times; and that it should not be calculated as exceeding 7 tons per square inch when strains of this amount would be applied to it many times daily. In some of the principal suspension road bridges it was said that a maximum of about 9 tons per square inch of section in tension was imposed on extraordinary occasions, while railway bridges were frequently subjected to the maximum calculated strain, a limit of 5 tons being in this country generally adopted. From this practice it was assumed that a margin, for errors of design and for other practical defects, of only 25 per cent. was allowed in permanent structures. The importance of sound principles of design was, therefore, manifest. The parts most difficult to design were the connections of portions of the structure with riveted joints. It was desirable that the area of the section of the rivets to be sheared, as well as of the plates forming these connections, should be somewhat in excess of the sectional area of the plates or bars which they connected; and that as the process of punching the rivet-holes in the plates, &c., had a tendency to weaken them in a greater proportion than that in which the area was decreased, it was advantageous to drill all rivet-holes in parts exposed to tension. It was represented that the general principles of design were well illustrated by a joint made of a single pin, such as that used in suspension-bridges, Warren girders, &c. Examples of various forms of links were presented for consideration, and a form of link of equal thickness, but with an enlarged head, was said to have been proved by experiment to be of about equal strength in all its parts. The proportions of these links were—

The bar ..... A being 100  
The diameter of pin ..... B = 75  
The depth of head beyond pin ..... C = 100  
The two sides of the pin-hole ..... D = 125  
And the radius of the curve of neck ..... R = 150

Links of these proportions, with larger pins and narrower sides—Nos. 7 and 7a—and larger pins and sides of the same width, Nos. 8 and 8a, made of iron of exactly the same strength, and links of proportions precisely similar to those adopted for the Menai, Nos. 9 and 9a; the Pesh, Nos. 10 and 10a; the Chelsea, Nos. 11 and 11a; and the Humberford, Nos. 12 and 12a, were compared. Taking the strength of the standard form, 22-125 tons per square inch of bar area, as=100, the percentage of gain or loss in power of resistance to ultimate strain by the use of the other forms of links, as follows:—

7 and 7A = 100  
8 and 8A = 79.9; loss = 21.1 per cent.  
9 and 9A = 104.7; gain = 4.7 "  
10 and 10A = 92.0; loss = 8 "  
11 and 11A = 79.8; loss = 21.2 "  
12 and 12A = 89.2; loss = 10.8 "  
13 and 13A = 85.4; loss = 14.6 "

The necessity for strengthening the heads of links, and for testing all of them with a strain equal to at least 10 tons per square inch of bar was proved, it was believed, by the experiments quoted and by the evidence of Mr. Provis in his work on the Menai Bridge. It was urged that an examination of the diagrams would show that some links failed with a less degree of stress, on account of the junction of the mass of the head with a comparatively smaller section of bar, by means of a curve of too short radius. This imperfect principle of construction also operated in causing fracture across the centre of the heads on both sides of the pin-hole; and in such designs, the question of the direction of the strain being truly along the axis of the link or bar, and of the strength of the material on both sides of the head being equal, should be considered.

The author next directed attention to the unsatisfactory state of the knowledge of the profession respecting the power of struts of various proportions and forms to resist compression, and stated his belief that the formula which had been proposed to facilitate calcu-

\* Read at the Institution of Civil Engineers meeting, on Tuesday, May 3.

lations for determining the strain which such columns would bear produced results which neither agreed one with the other, nor with any series of such experiments as had been tried. It seemed probable that for the present error might be best avoided by referring to the results of experiments made upon columns, &c., the conditions of which were analogous to the case under consideration.

With respect to cast-iron, it was stated that a mixture of iron for sleepers had produced bars 2 in. by 1 in. in section, which, when placed on bearings 3 ft. apart, had on the average of 1151 experiments during the last three years borne 33·4 cwt. placed on the centre, and castings 1½ in. in length and exactly 1 in. square, which on the average of 1002 experiments had borne 13·07 tons of tensile strain. An attention to the amount of deflection of the test bars had been beneficial, the average strain required to break the sleepers having been raised since the amount of deflection of the bars with a given weight had been increased. For the purpose of ascertaining the comparative strength of precisely similar girders cast with iron of varying degrees of strength, as represented by the ordinary test-bars, and when subjected to a direct tensile strain, the experiments detailed in the appendix (table No. 7) were tried, the girders being cast of the exact form and dimensions of three of those described in Sir Wm. Fairbairn's "Researches on the Application of Iron to Buildings." The results were as follows:—

The strength per square inch of section was represented in girder No. 1 by—

Mr. Fairbairn's experiments .....	as = 3214 lbs.
The first series of special experiments .....	as = 4977 lbs.
The second series of special experiments .....	as = 4977 lbs.

In girder No. 2 by—

Mr. Fairbairn's experiments .....	as = 3346 lbs.
The first series of special experiments .....	as = 5264 lbs.
The second series of special experiments .....	as = 5308 lbs.

In girder No. 3 by—

Mr. Fairbairn's experiments .....	as = 4075 lbs.
The first series of special experiments .....	as = 4988 lbs.
The second series of special experiments .....	as = 6500 lbs.

The strength of the test bars and the tensile strength of the iron used by Sir Wm. Fairbairn were not stated, but it might be assumed to be equal to about 25 cwt. placed on the centre of the bars, between bearings 3 ft. apart, and to a tensile strength of about 7 or 8 tons per square inch. The strength of the iron employed in the special experiments was represented by a weight supported by the test bars, varying from 30 to 38 cwt., and by a tensile strength varying from 10·25 to 13·94 tons.

In order to secure these results, the following conditions were represented as important, and should be considered in the design and execution of cast-iron work:—1. The strong iron referred to was obtained by the mixture in the furnace of four or five brands, some being harder than others. In order to amalgamate as far as possible these different qualities of iron, the furnace should be charged with them mixed in proper proportions in every basketful of metal which was emptied into it.—2. There would be a difference of about 16 per cent. between the weight that a 2-in. by 1-in. test bar would support when cast on edge and proved as cast, and that which it would support when proved with the underside as cast placed at the top as proved, and a difference of about 8 per cent. between the weight the same test bar would support if cast on its side or end, and proved on edge. This difference it would be necessary to take into consideration in estimating the strength of a large casting made from the same metal as that used in the test bars. Another, and probably the most important practical consideration, in respect of the strength of castings, was the proportions of their several parts being such as would free them as much as possible from unequal contraction in cooling. It was not often practicable to effect that which would avoid this—to adopt an equal thickness of metal in all parts of the casting, and it was, therefore, important that some means should be taken to prevent the castings from cooling too quickly.

The author drew attention to the experiments which had lately been tried with steel—more especially Bessemer steel—which experiments he considered justified the adoption of the following conclusions:—1. That Bessemer steel would bear before rupture a minimum tensile strain of 33 tons per square inch of section, and stretch about 1 inch in 12 in. of its length.—2. That the same material would bear either in tension or in compression a minimum stress of 17 tons before the extensions or reductions of length per unit of strain became irregular or excessive, as compared with those which had preceded them—in other words, before the yielding point of the material was reached.—3. That this material would, probably, contain about 45 per cent. of carbon chemically combined with the iron.—And 4. That this description of steel, if properly made and annealed, was as uniform in quality as wrought-iron, and, therefore, might be employed (precautions being taken to test its quality as a substitute for wrought-iron), while allowing an increase of strain upon it of 50 per cent.

**THE INSTITUTION OF CIVIL ENGINEERS.**—At the meeting of this society, on May 3, Mr. Charles B. Vignoles, F.R.S., President, in the chair, eighteen candidates were elected, including six Members: Mr. John Henry Eustace Hart, acting examining engineer for Government Reclamation Works, Bombay Harbour; Mr. Robert Jones, engineer-in-chief to the Commercial Gas Company; Mr. William Moore, Glasgow; Mr. Alexander Lawrie Nimmo, Westminister; Mr. Peter Scott, resident engineer, Madras Railway; and Mr. Edward Baylies Thornhill, resident engineer, Ashby and Nuneaton Railway. Twelve gentlemen were elected Associates: Mr. Frederick Morris Avern, examining engineer, P.W.D., India; Capt. Francis David Millett Brown, V.C., late assistant principal, Thomson Civil Engineering College, Roorkee, India; Mr. John Theobald Butler, Kirkstall Forge, Leeds; Mr. Thomas Carrington, jun., manager of the Kiveton Park Collieries, near Sheffield; Mr. Robert Elliot Cooper, Leeds; Mr. William Frederick Crawford, B.A., T.C.D., engineering staff, Madras Irrigation and Canal Company; Mr. John Brecken Everard, Student Institution of Civil Engineers, Leicester; Mr. Robert John George, late engineering staff of the Delhi Railway; Mr. George Rusbout Gordon, Westminster; Mr. John Anthony Kendal, contractor's staff, Ceylon Railway; Capt. Grenville Pulteney de Palezieux Falconnet, R.E., examining engineer, P.W.D., India; and Mr. William Roberts, assistant general manager of the Great Southern Railway of Buenos Ayres.—[We understand that the late Mrs. Appold has left to the Institution a legacy of 1000l., payable at the same time as the legacy for a similar amount from her husband, the late Mr. J. G. Appold, F.R.S., Associate Institution of Civil Engineers. It is believed that the bequest has been made "for the general use and benefit of the society," without being fettered with any conditions.]

#### SOUTH MIDLAND INSTITUTE OF MINING, CIVIL AND MECHANICAL ENGINEERS.

An ordinary monthly meeting of members was held in the School of Art, Wolverhampton, on Monday. There was a numerous attendance, and Mr. HENRY BECKETT (President) was in the chair.

The President and the secretary (Mr. J. COPE) reported that they had been unable, from local causes, to obtain an interview either with Mr. Stokes of Sarnon, as to the result of certain experiments in searching for coal, and with Major Lovelidge, as to the forming of a class for teaching science at the Institute in which they were then met. Both subjects were left for debate.

Mr. B. P. WALKER read a paper upon Boiler Explosions—a subject to which he had evidently given great attention, alike as a practical man and a man of science. The paper examined at considerable length the different causes to which boiler explosions were attributed, such as the evolution of explosive gases, electricity, and the spheroidal condition of water; that these were the causes, he argued, was inconsistent with their present knowledge of the subject. The real causes of explosions could be detected by inspection; and he believed that thoroughly accurate and intelligent inspection would almost do away with explosions. Then the anomalous relation of the strength of boilers to the pressure under which they had burst suggested some uncertainty in the mode of calculating their strength. The paper was illustrated by diagrams prepared by Mr. E. B. Marten, the chief engineer of the Midland Boiler Inspection and Assurance Company, whom he thanked, and to whose recently published book, giving a large number of cases of boiler explosions and their causes, he referred in terms of high admiration, because of the information which it furnished as to the real and not theoretical causes of boiler explosions. The diagrams which Mr. Walker used, and which was coloured, and was 12 ft. long by 5 ft. wide, showed (1) how in a boiler short of water having the feed afterwards put on, the water did not come into contact with the hot plates, because it was conducted to the bottom of the boiler; (2) how impossible the decomposition of steam or the formation of electricity is within a boiler; and (3) how impossible it was for water to take the spheroidal form within a boiler. The diagram also showed the chief defects in the making and repairs of boilers, noticing with prominence the disastrous results which often follow from unskilful "drifting."—Mr. Walker was warmly thanked for his paper, on the motion of the President.

Mr. E. B. MARTEN exhibited models of explosions which had occurred during this year. Model No. 1 showed how a Cornish boiler had exploded through corrosion in the bottom flues. No. 2 was that of a Lancashire boiler, which had exploded through weakness, brought about by too frequent repairs to the shell. No. 3 showed the explosion of a plain cylindrical boiler through overheating, the water "kicking" through one boiler to another. No. 4 was the collapse of the tube of a Cornish boiler through weakness. No. 5 was a balloon boiler, that had burst through corrosion of the angle-iron at the bottom. No. 6 was the explosion of a rag boiler used in pipe making, and not for generating steam, illustrating how a disastrous explosion may result from the rupture of a vessel filled with steam only at 60 lbs. pressure. No. 6 comprised

three domestic boilers, which had exploded through the stoppage of the pipes by frost, and leading to the conclusion that the danger might be prevented by having a circulating boiler inside the boiler exposed to the fire, on the principle adopted in the case of a glue-pot.

A short discussion followed, in which Mr. J. P. Baker (Her Majesty's Inspector of Mines), Mr. Holcroft, of Bilston, Mr. Silas Bowley, and the hon. sec. took part. In reply to Mr. Baker (who personally thanked Mr. Walker for the information he had given them), Mr. WALKER bore testimony to the very remarkable decrease in the number of explosions in South Staffordshire in the past eight or ten years. This was, no doubt, attributable to the periodical inspection of boilers that now took place. A similar result had followed the adoption of the clause now under consideration in the Manchester district. Such inspection universally adopted would render Government inspection unnecessary. He also thought it would be well if some of the old worn-out and disused boilers were subjected to a test, both by steam and by hydraulic pressure, to show the amount of strain they would bear, and the way in which fractures took place.

Mr. MARTEN replied that arrangements had already been made with some of the large firms in the neighbourhood for testing boilers in the way suggested by Mr. Walker, but there had not been a suitable opportunity as yet for making a test.

Mr. JOHN LAXTON then read a paper upon the Thick Coal on the western side of the Great Western Fault in Sandwell Park. Some of the views expressed by the writer are not so confident as to the probability of the existence of coal in a certain portion of the locality as are entertained by many of the gentlemen who knew the neighbourhood well. Nevertheless, Mr. John Laxton expressed his conviction that Mr. Laxton had replied to a question as to certain data in the paper put by Mr. Blakemore, of Heath Town, the author was thanked, and the meeting was over.

#### THE MINES REGULATION BILL.

A large and influential meeting of gentlemen interested in Cornish mining was held at Tabbs' Hotel, Redruth, on May 6, at the instance of the committee appointed to watch the progress of the Bills for the regulation of mines, introduced by the Government and Lord Kinnaird, the special object being to consider the course that should be adopted in reference to clause 7 of the Government measure, which would limit the time of work of children under 13 at surface to 6½ hours per diem. Mr. T. S. BOLITHO occupied the chair, and there were present Messrs. Warington Smyth, W. Shilson, A. Williams, C. Fox, T. Cornish, H. Grylls, W. H. Grylls, W. Bolitho, R. Grylls, W. Polkinghorne, J. G. Dymond, C. Childs, S. H. James, R. Boyes, S. Jenkin, G. Abbott, J. Haye, J. K. Cartwright, Dr. Michael C. Thomas, R. T. Richards, D. W. Bain, J. Thomas, E. Rogers, A. T. G. Downing, J. West, A. Lanyon, R. Prior, and other gentlemen.

The CHAIRMAN said the meeting were aware that Lord Kinnaird had withdrawn his Bill on condition that certain portions of it should be embodied in the measure which Mr. Bruce had introduced; and that the latter gentleman had also agreed to certain amendments of a satisfactory character being made. He refused, however, to give up clause 7, which the committee thought to be most objectionable—(hear, hear)—and they had met to discuss what, under these circumstances, should be done. Mr. St. Aubyn and Mr. Pendarves Vivian would have been present had he (the Chairman) thought it necessary, but seeing that the clause was in the Bill, and that the committee in other matters, he had considered it unnecessary to move. From numerous letters which he had received from those gentlemen he gathered that the other persons interested in metalliferous mines throughout the country were prepared to join with Cornwall in opposing the clause, and Mr. Vivian was led to believe that it would be also opposed by the proprietors of the Welsh collieries. The lead miners of Derbyshire and Cumberland felt strongly aggrieved, and were waiting to see what Cornwall did. Therefore, they had really a strong opposition. (Hear, hear.) Mr. Magniac wrote to say that in the Midland Counties the Workshops Act, which it was intended to introduce, was almost a dead letter; and that among the lace makers and straw plaiters of Bedford there had been very little success in enforcing it. Communications had also been received from the members for East Cornwall, who were rendering every assistance in their power; and from Mr. Adolphus Young, who joined in the opposition, and said that the education of mine children ought to be dealt with under the general Act. (Hear, hear.) Mr. Hill and Capt. Williams had written regretting their inability to attend, as had Mr. Henry Rogers, who suggested that a compromise might be effected by giving the children two half-holidays a week; and insisted upon the necessity of more educational work being done in Sunday and evening schools. He might point out, before leaving the matter in the hands of the meeting, that the exact operation of the clause would be that no children below 13 could be allowed to be employed for more than 6½ hours a day, with a half-holiday on Saturday, and that only on the condition that they brought with them each Monday morning a certificate that they had attended school 10 hours in the previous week, between eight in the morning and six in the evening, which excluded, therefore, evening and Sunday schools.

Mr. WILKINSON SMYTH said the evil with which they were menaced by the clause was of a double kind—in the first place the interests of those who had embarked money in metalliferous mines was threatened, and in the second the character of their future working men. Hitherto for truth and thoroughness of workmanship England had held her own against all countries, and Cornish miners stood pre-eminent in their class; but if the latter did not begin to attain experience in early life on the surface a very serious falling off must arise. (Hear, hear.) Mining enterprise had had much to depress it, and it was hard that this last blow should be inflicted by their own statement. He thought they could not do better than oppose the clause, which was founded upon principles that were really inapplicable to the metalliferous mines, and which, if carried out, by reducing the number of children employed, would cause great distress in many a home, old miners and widows especially suffering.

Mr. SHILSON, after some discussion as to the exact form the resolution should take, moved "That this meeting, representing a large body of landowners, shareholders, and managers of mines, and many others deeply interested in the welfare of the mining population of Cornwall, desires to express in very strong terms its entire disapproval of clause 7 of the Mines Regulation Bill; and after the fullest consideration of it is satisfied that the attempt to limit the hours of work of persons under 13 years of age to 6½ hours daily would, to a very great extent, prevent the employment of children; and while it would prove injurious to the mines, would be far more detrimental to the working miner, and could not fail, by diminishing the earnings of families, to tend to the increase of pauperism." (Hear, hear.) He recapitulated the arguments for the rejection of the clause, and suggested that, if adhered to by Mr. Bruce, it should be modified by altering the age from 13 to 11, and by limiting the time of work to 40 hours per week instead of fixing an absolute limit for each day. (Hear, hear.)

Mr. C. FOX suggested that the age might be made earlier for children who could read. Five-sixths of those at present employed on the mines could either read or write.—Mr. J. G. DYMOND remarked that of 35 at South Caradon 24 could read, and 23 could write. (Hear, hear.)—Mr. R. GRYLLS believed that education would advance wonderfully if the ability to read and write were made the condition of employment.

Mr. DOWLING forcibly argued the inapplicability of the Workshops Act to Cornish mines. The half-time system would never work, and the result of its introduction would be to throw children out of work, and thus to throw back education. (Hear, hear.)—Mr. A. WILLIAMS seconded the motion.

Mr. H. GRYLLS, Mr. BOYES, and other gentlemen contended for a determined opposition to the clause, and Mr. SHILSON read a passage from a letter by Mr. St. Aubyn, stating that no effort should be wanting to effect that result. (Hear, hear.) Mr. CHILDS was doubtful of the propriety of introducing the reference to pauperism, the answer to which would be that they must pay their men better. The CHAIRMAN replied that the reference could be omitted, but that, undoubtedly, the clause would increase pauperism in many a widow now kept her family from the parish by the labour of her children—and would also increase emigration, which was another very serious evil.

Mr. CHARLES FOX having expressed similar views, the resolution was carried unanimously.

On the motion of Mr. ARTHUR WILLIAMS and Mr. BOYES, it was then decided to appoint a deputation to wait with the local members and deputations from other parts of the country upon the Home Secretary, and set forth the objections to the clause. Messrs. T. S. BOLITHO, Warington Smyth, R. Taylor, W. A. Thomas, Boyes, and Mr. Dymond were named as the deputation, with power to add to their number; and it was decided to leave the question entirely in their hands to adopt what course they thought best.

The proceedings were brought to a close by a discussion of Mr. MAGNAC's proposal concerning the appointment of mine doctors. It appeared that in some mines a system very similar to that which Mr. Magniac advocates is already in force, and it was decided all but unanimously that the matter was not one which should be interfered with by legislation, and that Mr. Magniac should be asked to withdraw his amendment.

**ROYAL CORNWALL POLYTECHNIC SOCIETY.**—The Prize List of the Royal Cornwall Polytechnic Society, just issued, contains, in addition to what we may call the routine prizes, a list of several special premiums to be competed for at the Exhibition in September next: 100l. is offered for the best model, and 50l. for the best plan for improving the ventilation of mines. The Editor of the *Mining Journal*, in conjunction with the society, gives 20l. to the originator of improvements in ore dressing which have been in successful operation not less than six months. The Editor of the *Mining Journal* also offers 50l. for the best paper—accompanied by drawings—giving an account of any methods or plans practised in other mining districts advantageously, applicable to Cornish mines. The introduction of improved methods of drawing the ores and rubbish from the Cornish mines appears to the committee to be worthy of attention with reference to these premiums. Colonel Tremayne offers 50l. and the society 20l. for the most exact account of the phenomena of mineral veins in any one district, their dip, direction, variations in productivity, slides, heaves, &c. The society being especially desirous of cultivating close habits of observation in miners, will give prizes for accurately drawn cross sections; for collections of ore and country in which the relations of one to the other are carefully marked; for drawings and descriptions of any remarkable phenomena observed in lodes, &c. The society offers five guineas for the best working plan of a mine drawn by the person who drilled the workings. Mr. Charles Fox will give premiums of three, two, and one guinea for the first, second, and third class models of steam-stamps (to possess a stamping power equivalent to that of three or four heads) which may be removable from place to place, whether attached to wheels or on frames, to be transported on a wagon; or for such improvements, especially in the stamping part, in steam-stamps, whether stationary or locomotive, as may simplify the machinery, whether of the engine or of the stamps, without impairing its efficiency. Should the Judges be unable to decide that such alterations are, on the whole, an undoubted improvement, the premium should be considered as saved. The society also offers 50l. for the best practical essay on the improvement of Cornish river fisheries, especially with refer-

rence to salmon. An additional premium of 10l. by Mr. R. R. Broad and 10l. by the society will be awarded if the suggestions are carried into effect. Captain Teague and the adventurers in the Tincroft Mine have also offered 100l. and the society 50l. for the best practical suggestions, with models or drawings, as to the motive power to be employed in driving boring machines in Cornish mines, including the method of conveying the power to the machine. The Editor of the *Mining Journal* gives "Burgh on Steam Boilers and Engines" for the best mechanical drawing by youths not receiving another prize. So far mining and mechanics. Then in natural history there are offered a premium of 20l. or books to that value, for the best Illustrated Journal of Natural History. A premium of 20l., or books to that value, for the best Calendar of Nature, presenting in a tabular form the comparative view of the dryness or moisture of different years; exhibiting also the advance of the seasons by the time at which various trees, plants, &c., burst into leaf or flower, taking of course the same tree each year. The candidates to be under 18 years of age. Premiums of 20l. for the best, and 10l. for the second best, collection of Cornish organic fossils are offered by Mr. A. Lloyd Fox. A number of special prizes are likewise offered in needlework by Miss A. M. Fox, Miss Hustler, and Mrs. W. P. Dimond.—*Western Morning News*.

#### MINING, METALS, AND MINERALS—PATENT MATTERS.

BY MICHAEL HENRY.

Patent Agent and Adviser, Memb. Soc. Arts, Assoc. Soc. Eng.

Messrs. R. C. WALLACE and W. CRAWFORD, of Ardrossan, have obtained a joint patent for an invention relating to pumps and mechanism connected therewith, applicable to ships and other purposes. This invention has reference to a new construction and arrangement of combined reciprocating pumps, and the gearing or mechanism for actuating them all, particularly designed and adapted for ships, but also applicable for other pumps and purposes. One modification of this invention, as applied to a set of vertically-working ships' pumps, consists in having two working barrels or cylinders connected at their lower inlet ends to one and the same single main lifting conduit or pipe, by preference by a Y-shaped branch-pipe, either cast in one, with or secured to the lower ends of the pump-barrels, which have each an inlet foot-valve a little above where the two cylinders branch into one at the main lifting branch, below which main single branch-pipe one or two or more conducting pipes and branches may be made to lead the water from the several places desired into the main branch and combined pumps, each or all of which branches being controlled by a separate or compound cock (or it may be valve respectively), so that the pumps may raise or draw the water from the particular place and pipe desired—as in ships' pumps from the "bilge" or "main" respectively, in which case two pipes only would be required, controlled by a simple "two-way" cock for each pair of working barrels or pumps. The working "buckets," "boxes," or "plungers," and the "spears" or rods of these duplex pumps, one, two, or more pairs of which may be placed in a row, and worked as one set of pumps, by having the upper end of each rod directly connected to a crank or eccentric on a revolving and driving fly-wheel shaft, placed over the row of pumps or otherwise, as by preference each rod may be connected to the overhanging free end of a vertically reciprocating lever, one for each pump. These levers are by preference fulcrumed loose at their other ends on a single spindle and standards, each pump and lever being actuated from below by a fly-wheel shaft, and a revolving heart or other shaped cam upon it, one acting on a grooved pulley in each lever, or otherwise each lever may be actuated by a crank or eccentric on the driving shaft directly linked or jointed by a connecting-rod projecting upwards from them. The cams or cranks are so set on the shaft that the one pump-bucket will raise and draw up the water and liquid, while the other is descending into its barrel ready for the next lift, and the actuating shaft is by preference placed parallel with and as close to the pump barrels as the cams and cranks will revolve clear of them, and the shaft may be driven by winch-handles and manual power at each end, or by a small portable engine, or other motive power arrangement as desired. These improved arrangements of pumps may be made to force the water or other liquid as well as draw or lift it, as described, and they may be arranged to work horizontally or at an angle as well as in the vertical manner herein described.

Mr. THOMAS RAMSAY, of Gateshead, has specified an invention relating to apparatus for the manufacture of gas. In the manufacture of gas it is usual to charge the retorts at the ends, or retort mouth, the door being removed, and the charges thrown in with shovels or scoops, or machinery. According to this invention apertures are formed in the retorts, and from these apertures tubes or passages lead up to the top of the retort arch, or furnace, and are there closed with suitable stoppers, which are removed when charging. Railways or tramways are provided over the retort arch, or furnaces, on which trucks, with hopper-like bottoms, run. The charges of coal or other gas-making material are placed in these trucks, and are carried by them over the charging tubes or passages of the retort; the coal or material is then discharged by drawing out a slide or trap at the bottom of the truck, and falls into the retort; the coal or gaseous matter is then levelled and spread by tools introduced at the retort mouth or door, or end of the retort. The gas may be conducted off by the charging tubes or passages.

**VENTILATING MINES.**—The invention of Mr. J. FAULKNER, of Manchester, consists in affording every facility for the gas to escape and to be drawn off by fans, turbines, exhaust-pumps, heat, or other mechanical means. Where gas is known to exist the inventor taps, or drills, holes in the wall, and connects pipes to the holes, and then exhausts the gas by means before mentioned. He taps known blowers with a large hole either in the solid or at the fracture, but prefers the solid, as there is more certainty in governing the escape, and when it is unsafe for fire to enter the ordinary air-passages he provides pipes, sewers, or passages to allow it to flow away to a safe place, or to be collected in chambers and then drained off in non-working hours or otherwise, as convenient.

**FURNACES.**—The invention of Messrs. W. WALKER and D. DAVIES consists in applying a jet of steam against a fan or wheel, supported in bearings or revolving on a stand in the fire-door, or in the front plate of the furnace; the steam causes the fan or wheel to rotate rapidly on its axis, and the draught in the chimney induces a current of air into the furnace, while the rotation of the fan or wheel causes the air mixed with the steam to pass over the fire on the grate.

**UTILISING WASTE HEAT FROM FURNACES.**—The invention of Mr. A. F. WILSON, Pala, Brazil, consists in utilising the products of combustion or waste heat escaping from the retort ovens into the main flues, for heating the air before its admission to the furnaces for sustaining combustion therein. This may be done in various ways, but by preference the inventor constructs chambers above the retort benches, or otherwise, and divides such chambers by means of walls or partitions, so as to form large flues or passages arranged to cause the products of combustion to travel backwards and forwards along the chambers. Within these tubes or passages he places tubes, through which the air for admission into the furnace is passed, so as to raise its temperature on its way to the fires, and thus to effect considerable economy in the consumption of fuel.

**SAFETY-LAMPS.**—By the invention of Mr. A. H. GILMORE, of Edinburgh, he fits a central cap, or extinguisher, to slide up and down the vertical guide-rods, extending downwards from the upper part of the lamp to within a short distance of the flame. The extinguisher is provided with a cross-head, and above it is placed a spiral spring, which, pressing on the top of the extinguisher, operates its descent in the guides before mentioned. When the lamp is to be ignited for use the extinguisher and spring are compressed at the upper part of the lamp by means of two rods connected by a ring at their upper ends. Each of these rods is further provided with a small horizontal quadrant-shaped piece, serving as a support for the ends of the cross-head above mentioned, as fixed on the extinguisher, and serving to maintain the latter in its raised position.

**TREATING ORES.**—The invention of Mr. J. STUART, of Limehouse, consists in subjecting the ores of metals and their products, such as, for example, the roasted sulphides of the metals, to the action of chlorides of sodium or of chlorides of potassium, in conjunction with silicates of alumina, or compounds of alumina or silica, at an elevation of temperature, and either with or without the vapour of water. It is preferred to use as most convenient clay, felspar, or fullers' earth; this is done in retorts, ovens, reverberatory furnaces, or in any other convenient way of applying heat. Through this treatment certain reactions take place, chlorides of the metals in the ores under treatment are formed, and aluminates or silicates of soda or potash are also formed. From the chlorides so formed the inventor manufactures the oxides or the carbonates of the oxides of the metals, or the metals themselves, as may be desired. From the aluminates or silicates of soda or potash so formed soda or its carbonates are obtained.

**LOCOMOTIVES.**—Messrs. F. W. FOX and E. WALKER, of Bristol, construct a closed fire-box, or furnace, lined, by preference, with fire-brick or ganister, into which atmospheric air and liquid hydrocarbon are forced by a pump worked by the engine, for which purpose the hydrocarbons may be made to issue from a small pipe situated centrally inside the air-pipe, the air and hydrocarbon being made to pass into one or more perforated tubes in the bottom lining into the furnace, from the perforations of which tube, or tubes, they issue through corresponding perforations in the lining into the furnace, where they enter into combustion. Or the air and hydrocarbon may be forced through separate pipes and apertures into the furnace. In the furnace are arranged walls or loosely piled pieces of fire-brick, with interstices between them, into which the flames and hot gases resulting from the combustion rise, so as to heat the fire-brick to a high degree, and thus produce a reservoir of heat.

**STEAM-BOILERS.**—The invention of Mr. R. CRICKMER, of Dorchester, consists chiefly in so arranging the parts of the apparatus that the area of the passage leading from the boiler to the engine, or apparatus where it is

steam is to be used, is increased or diminished automatically according to the pressure of steam in the boiler—that is to say, when the pressure is low, and the steam is being generated slowly, the area of the passage is so reduced, in size that the steam can only be taken slowly from the boiler; but as the pressure in the boiler increases, and the evaporation becomes more rapid, the area of the passage is increased to a corresponding extent.

**FURNACES AND STEAM-BOILERS.**—Mr. J. SAWYER, of Alma-street, proposes to construct furnaces and boilers of round, oval, or square tubes, made of wrought-iron or steel. The tubes are fixed longitudinally or cross sectional, as the shape of the boiler may require. The tubes are screwed or rivetted to a hollow wrought-iron bridge at the back or far end of the furnace; they are also screwed to a wrought-iron dead-plate at the front end of the furnace; the hollow bridge and dead-plate are connected to the boiler by means of tubes or pipes, forming an inlet and also an outlet. By this arrangement the water is supplied from the boiler to the tubes which form the furnace whereon the coal or fuel is placed. The air-passages forming the furnace will be in proportion to the quantity of air required to combust the fuel.

#### FOREIGN MINING AND METALLURGY.

It appears that the Aubin Works, carried on by the Orleans Railway Company as part and parcel of its general undertaking, produced in 1869, 181,158 tons of coal, 21,401 tons of rails, and 548½ tons of argenteiferous lead minerals. The production of the last-named minerals showed an increase last year, but there was a falling off in the quantity of coal extracted, and in the weight of the rails manufactured; this falling off was due to the grave disorders of which the company's works were the theatre in Oct., 1869. The price of labour also experienced a sensible advance last year. All these circumstances combined have reduced the profit realised in 1869 to 17,120*l.* The staff employed at the works has been reduced by the retirement of M. Callon. The company has laid down steel rails during the past year upon its section from Paris to Orleans. These rails, tried in the first instance upon the Etampes incline, have produced excellent results; they have been laid down for a distance of about 22 miles, and the process of laying them is to be continued to Tours also. The quantity of coal carried over the company's old network increased last year to the extent of 92,000 tons, as compared with 1868. Steel rails were laid down upon the Paris, Lyons, and Mediterranean system last year to the extent of 109 miles. The quantity of coal and coke carried over the Northern of France Railway last year was 5,727,000 tons; the system is that by which supplies of Belgian coal find their way into France. The Eastern of France Railway Company has given out orders for 22 locomotives, 12 tenders, and 1280 goods trucks, to be delivered in the course of 1870. The company is about to apply to the French Government for concessions of two mineral lines, which would form branches of the line from Longwy to Mont St. Martin. So much for current French railway gossip.

Affairs maintain a very favourable and encouraging appearance in all the French groups. In the Haute-Marne all descriptions of iron are in good demand, but rough pig enjoys, probably, the most favour. There is some want of disposable charcoal-made pig, and orders have been a good deal directed, in consequence, to mixed pig, which is held at 4*l.* to 4*l.* 4*s.* per ton, according to quality. Mention is made of a contract for 100 tons half mixed coke, half charcoal-made, concluded at 4*l.* 8*s.* per ton at the works. Coke-made iron enjoys a good current of orders, and it is the same with sheels and axes. The foundries are better employed than for some time past; a fair number of orders have been received, but founders complain, nevertheless, of some reserve on the Paris market. Machine iron is taken off as fast as it is produced. At the last meeting of the Champagne Committee of Forgemasters some attention was devoted to the proposal of a canal from the Oise to the Aisne, and a wish was expressed that the project should be realised as speedily as possible. The committee expressed upon the Government the importance of a uniform depth of water in all its canals, and especially in those of the North and the East of France. The committee gave its adhesion to a proposed fusion of the colliery companies of the Moselle, under the auspices of the General Company for Promoting Commerce and Industry in France. Rough pig maintains itself well in the Moselle, and also in the Haute-Marne; disposable is wanted, and a quotation of 2*l.* 18*s.* 4*d.* to 2*l.* 19*s.* 2*d.* has been established for small lots; in the case of more important contracts easier rates would, however, be accorded. Specified pig is dealt in at 1*s.* 8*d.* to 1*s.* 6*d.* per ton less than the market price. Iron has not all gone, but the market is not all tight, and price, and all the rolling mills are actively employed. The two great furnaces of Hayange will be lighted in the course of the month. It is stated that Messrs. P. Girard and Co. intend to establish a third furnace at Longwy Bas. At the Willerupt Works there are now four furnaces lighted, three with charcoal and one with coke; the works are also making considerable quantities of wagon wheels. Outage has three furnaces in activity, the daily production of which amounts to from 25 to 30 tons of rough pig for refining and casting purposes; it is proposed to extend the furnace. It has been stated that the proprietors of the Liverdon Works intended to construct a third blast-furnace, but this is an error, the Customs legislation now in force, and the increase in the tolls levied on canals in the East of France, not being calculated to encourage an extension of metallurgical industry. The Western of France Railway Company has ordered 46 locomotives of various types from MM. André Koechlin and the Gravenstaden Works. The Compagnie des Chantiers de l'Océan is also to supply the same undertaking with thirty tenders.

Some hesitation prevailed at first as to the renewal of coal contracts in Belgium, but it seems to have disappeared in presence of unassailable firmness in prices, and a continued amelioration in the state of the principal basins. Some merchants begin to accept the conditions proposed to them, and everything leads to the belief that the great body of intending purchasers will not be long in following their example. The Belgian collieries would then have their future satisfactorily assured, so far as the season now commencing is concerned, were there not some fears of a probable strike. A proposal for the assumption by the State of the lines hitherto worked by the Belgian General Railways Working Company has been very favourably received in the basins of Charleroi and the Couchant de Mons; the latter basin is promised the construction of lines from Dour to Quivier, and from St. Ghislain to Ath. The demand for coke continues very active; and, notwithstanding the considerable addition which has been made to the production, it is still difficult to satisfy the requirements of industry. Some important contracts are stated to have been concluded recently with industrialists of the Moselle and the Grand Duchy of Luxembourg at satisfactory rates; and the ensuing season is considered to be assured; the only uneasiness of coke producers lies in the difficulties which they may meet with in securing the full quantity of coal which they will require. Tenders are again invited, and this time on easier terms, for a quantity of Vignoles cast-steel rails, with accessories, for the Belgian State lines. The Belgian rail-producing interest has been invited to compete for 7000 tons of Bessemer steel rails, to be delivered for lines in the colony of Victoria (Australia) before the close of November, 1870. The state of the Belgian iron trade has not experienced any material change; the feebleness reported recently in merchants' iron continues, plates are in good demand, and very firm, and rails maintain the high quotation of 7*l.* 4*s.* per ton. Such a quotation as this has not been attained for the last 10 years, the average price of first-class iron rails, with accessories, having been 6*l.* 6*s.* 7*d.* per ton in 1869, 5*l.* 19*s.* in 1868, 6*l.* 5*s.* 4*d.* in 1867, 6*l.* 8*s.* 1*d.* in 1866, 6*l.* 9*s.* 5*d.* in 1865, 6*l.* 8*s.* 7*d.* in 1864, 5*l.* 19*s.* 4*d.* in 1863, 6*l.* 0*s.* 4*d.* in 1862, and 6*l.* 9*s.* 3*d.* per ton in 1861. The average price for 4*l.* in 1870 will probably be 7*l.* per ton, at least, as independently of the orders in course of execution, which are still very considerable, there are requirements to be satisfied which will not be long in making their appearance.

**EXTENSION OF THE AUSTRALIAN COAL TRADE.**—Some recently published statistics show a marked falling off in the shipments of coal to the East Indies and China, the decrease being in 1869 about 120,000 tons. This falling off is said to be owing partly to the fact of the previous year's export being considerably in excess of actual requirements, thus leaving heavy stocks at most of the ports; and, secondly, to the largely increasing supply of Australian coal. The quantities of this coal now shipped to China and the Indian ports, where it seems to be still gaining favour, are such as to materially affect the market for English coal. The decrease is chiefly observable at the Indian ports, as will be seen from the following figures, taken from a table of shipments from home ports, from January to November of the following years:—

	1867.	1868.	1869.
Bombay .....	293,788	245,614	197,342
Point de Galle .....	74,264	56,319	44,052
Calcutta .....	78,235	29,459	29,462

At Singapore there has been an increase of nearly 20,000 tons during the same period. The shipments to Hong Kong for the three periods are respectively 54,209, 59,400, and 52,773 tons. Shanghai exhibits a falling off from 50,763 tons in 1867 to 36,223 tons in 1869. The total quantity of coals shipped from the United Kingdom during eleven months ending November 30, 1869, 8,965,460 tons, showed a decrease of 238,838 tons compared with that shipped during the corresponding period in 1868. This check to the coal trade is apparently destined to be only temporary, and dealers in Australia as well as in England, may derive encouragement from the strides that are now taking place in the development of steam traffic. From authentic sources we learn that there are now in course of construction in Great Britain, or have been lately completed, for account of Liverpool lines already established about 26,000 tons of steam shipping, for employment in the Atlantic, Eastern, and Pacific trades; and for several lines about to be established for the Eastern trades, 34,000 tons independent of steamers intended for short and miscellaneous trades, 5000 tons; to be added to which are 10 steamers, some of which have been lengthened, and others about being so, representing an increase of tonnage of about 100,000 tons; making a total of 105,000 tons, thus showing an increase of about 100,000 tons of steam tonnage, or an equivalent to about 300,000 to 350,000 tons of sailing ship tonnage.—*Overland China Mail.*

**MINING IN AUSTRALIA.**—At Kurilla, the drive from Hall's shaft put through to drain Deebie's has reached the latter shaft at the 25 fm. level, 12 fms. lower than Deebie's has been sunk. It does not free Deebie's from water, but the fact of it being in ore of a very similar character to that above at the 13 fathom level is of very great importance, as it proves that the company has

12 fathoms of excellent ore to work upon, and how much more it is, of course, impossible to say. A very large quantity, probably, for the drive has come into the lode where it is yet composed of yellow ore, of a high percentage, underneath which there can be no doubt is the solid yellow ore of the district. A course of slate seemed to run through the lode, but after this was passed through in sinking yellow ore, coated black, with occasional specks of purple ore, was again found, slightly more solid than previously: 80 tons of ore were sent from the mine last week. There is a slight improvement in Hall's shaft, some good stones of ore coming up. Two pitches are working in Hall's shaft.—*South Australian Register, March 1.*

**COLORADO—SALE OF THE TERRIBLE MINE TO ENGLISH CAPITALISTS.**—The Georgetown Miner, March 31, announces with great glee the sale of one-half of the Terrible Mine for a very large sum to British capitalists. It says:—"We seize with strange alacrity the opportunity afforded us for giving publicity to a statement of stupendous magnitude. One-half of the justly celebrated Terrible, the largest and richest silver vein in Colorado, has been purchased by a company of English mining capitalists, for a sum of money sufficiently large, if used for that purpose, to liquidate the interest on the national debt—estimating it at 2,500,000,000—for one day! This information comes from Mr. Henry Crow, former part owner of the recently purchased interest, who is in receipt of a telegram from his partner, Mr. F. A. Clark, now absent in England, and through whose negotiations the sale was effected. An agent of the English Company will be sent there immediately to take charge of the mine. Until the date of his arrival the workings of the mine will remain under the supervision of Mr. Crow. At this time the Terrible is producing a quality of ore such as will make glad the hearts of the foreign capitalists. We offer our highest congratulations to Messrs. Clark and Crow, in view of their recently acquired independence."—*Engineering and Mining Journal, April 26.*

#### FOREIGN MINES.

**CLEMENTSLUST (Copper and Lead), near Linz, in Prussia.**—Since the beginning of March the lode has been opened up by means of cross-cuts 25 fms.; for the entire length the lode is large and good, and carries a leader of copper from 3 to 4½ ft. wide, averaging 15 to 40 per cent. produce. This level being in whole ground, and the end driving south being as good as any part of the level, has discovered over the 27 fm. level at the least 16,800*l.* worth of copper ore in the last two months, and in these last two months more than 50 tons have been broken and brought to surface by 11 men, or an average value of 12*l.* 10*s.* per ton, worth 25*l.*, at a cost not exceeding, including all expenses, 80*l.* The stone of ore sent to the office of Mr. Wilson, 20, St. Helen's-place, London, was taken yesterday from the south end of the lode in our presence, and is well calculated to show the character of the lode; the weight is 339½ Prussian pounds, equal to 432½ lbs. English. This is, without doubt, the best copper mine in Prussia. The cost of sinking two shafts, one 15 ft. by 6 ft., and the second 8 ft. by 6 ft., will not exceed, every expense included, 15*l.* per fm., and 5 fms. monthly can be sunk in each shaft. The cost of driving the levels in this mine has averaged less than 3*l.* per fm., and 7 fms. in each can be driven monthly. The cost of stopping throughout the mine is an average of under 30*s.* per lachter. The cost of dressing the ores now being raised is very inconsiderable, as it is broken, picked, and sent to the smelter. The lower quality ores, being carbonates, phosphates, and malachites, are reduced by the acid process on the mine, and so prepared, average 68 to 70 per cent. of copper.—*MUEHLBEIN, Obersteiger; F. BECKER, Steiger; G. SCHWARTZ, Representant.*

**ALMADA AND TIRITO CONSOLIDATED (Silver).**—Mr. Clemes, the company's manager in Mexico, who only arrived at the mines on March 25, wrote to the company on the 28th of the same month. After remarking that the mine had not been properly worked, he continued:—"I only saw a little time to do the mine, and to do so doing to find a more or less productive part of the lode or an increase of miners." Mr. Breach, the assistant engineer, in his voluminous report, dated March 1, writes:—"If the mine had been opened from the air-shaft, by driving levels north and south, and also by keeping the present levels ahead of the stopes, there would have been room to place men to keep two or three shafts in the Tiritio in full work, and ventilation would have been provided for throughout the mine." The following is a copy of assays just made by Messrs. Johnson, Matthey, and Co., from 6½ tons of Bessemer metal, shipped to St. Francisco from the Tiritio Mine I received 227,000 lb. of metal, which was analysed as follows:—No. 1 specimen produced 63 per cent. of copper, and 299 ozs. of silver per ton of 2000 lbs. of ore; No. 2, 31½ per cent. of copper, and 1415 ozs. of silver; No. 3, 13½ per cent. of copper, and 399 ozs. of silver; No. 4, 47 per cent. of copper, and 1213 ozs. of silver; No. 5, 26½ per cent. of copper, and 360 ozs. of silver; No. 6, 29½ per cent. of copper, and 139 ozs. of silver; No. 7, crushed ore; mark, 131 sacks, 13,152 lbs.; produce of copper, 32½ per cent., and silver 388 ozs. per ton of 2000 lbs. of ore.

**SAO VICENTE.**—The mine capital reports (April 1) as follows:—"Jacotinga Formation: The No. 2 cross-cut has been extended 5 fms. 2 ft. In this level the lines seem more regular, and the jacotinga brighter in appearance. No. 4 cross-cut has been driven 3 ft. in this level we are still passing through small lines of jacotinga, clay, and sand. No. 5 cross-cut has been driven 4 fms. 5 ft.; we have got through the bed of canga and clay in this level, and in the upper part of the end we have bunches of jacotinga, but the level is not yet far enough advanced to get into settled strata. The above comprise all the points of operation at present."

**NEVADA (Land and Mining).**—J. J. Dunne, April 22: "Our smoke-stack (made of iron) burned out on Friday last, eaten and burnt up by the acids from the ore. I had been expecting it to fall in every day for a fortnight, and had bricks ready to build a new one, which I had completed on Wednesday morning, and we are in full blast since then. Last Tuesday I received 227,000 lb. of metal, which was analysed as follows:—No. 1 specimen produced 63 per cent. of copper, and 299 ozs. of silver per ton of 2000 lbs. of ore; No. 2, 31½ per cent. of copper, and 1415 ozs. of silver; No. 3, 13½ per cent. of copper, and 399 ozs. of silver; No. 4, 47 per cent. of copper, and 1213 ozs. of silver; No. 5, 26½ per cent. of copper, and 360 ozs. of silver; No. 6, 29½ per cent. of copper, and 139 ozs. of silver; No. 7, crushed ore; mark, 131 sacks, 13,152 lbs.; produce of copper, 32½ per cent., and silver 388 ozs. per ton of 2000 lbs. of ore."

**NEW WILDBERG.**—J. Sanders, May 7: "East Mine: The forebreast of the drive east at the Erbstein is not quite so good as last week; present value 1 ton of ore per lachter, but we expect it will improve again shortly. Consider the drive at the 70, at Erbstein, Erzhammer, has been carried on the hanging wall side of the lode; the forebreast is unproductive, but there is a great width of the lode standing between the drive and the wall, which we intend to stop, and hope by so doing to find a more or less productive part of the lode. This piece of ground, we believe, will turn out 1 ton of ore per lachter; and the stopes above this level is yielding 1½ ton per lachter. The rise and stopes above the 60, towards Johanne's sink, is, I am pleased to say, very much improved in the past week; the footwall of the stopes has been broken into, and some fine stones of ore taken from it. The men working there took the stopes on April 1 for two months, and if the ore continues throughout the present month they will get very good wages. There is no change to notice in the other stopes and pitches in this part of the mine, the average yield being 1 ton of ore per lachter. The cross-cut driving south at the 70, opposite Davey's stopes, is looking somewhat better than it has been, and some good dredge ore is being broken from it.—Beck's Workings: The cross-cut north at the 70 is unproductive; the tributaries and pitches remain as for some time past.—East Blumengang: This part of the mine remains as last week. The stopes above the 70 and that between the 70 and 60 are yielding two tons of ore per lachter respectively. The drive west at the 60 is yielding a little dredge ore, but not of much value at present.—West Blumengang: In my last report I remarked that in the drive east at the 60, the level to drive for 18 gr. per cent. for the ore; but I regret to say that the ore was very short, and to-day it is not near so good as it was."

**VAL ANTIGORIA (Gold).**—Thomas Roberts, May 3: "We consigned to-day to Sig. Carlo Menozzi, for remittance to the office in London, one ingot of gold, weighing 12 ozs. 4 dwts. 6 grs., obtained from 9½ tons of ore, during the month of April. From the 20 fm. level, on No. 2 lode, we have hoisted off the greatest part of the stuff, and have resumed sinking the incline shaft under the 20; the lode in the shaft yields 2 tons of ore per fathom. This incline will be pushed on with all speed. We hope to get it down to the 30 in three months. The ground in the cross-cut, driving east, has changed for the better. The stopes in back of the 30, on No. 1 lode, yield 2 tons of ore per fathom; and the stopes in back of the 30, on this lode, 1½ ton of ore per fathom."

**PESTARENA UNITED.**—T. Roberts, J. Mitchell, T. Warne, May 3: "We consigned to-day to Signor Carlo Menozzi, for remittance to the company's office in London, eight ingots of gold, of the weight of 548 ozs. 18 dwts. 2 grs.; this gold was obtained from ore treated in the month of April—152 tons at Pestarena by the small mills, 135 ozs. 14 dwts. 16 grs. at Battaglio establishment; 119 tons of ore from Pestarena gave 87 ozs. 18 dwts., and 532 tons from Val Toppa Mine 325 ozs. 5 dwts. 10 grs.—Mines: The stopes in the bottom of the adit, near the boundaries of Pescheira and Aquavite, yield 4 tons of ore per fm., worth 15 dwts. of gold per ton; and the stopes in the bottom of the 10 fm. level, worth 12 dwts. per ton. In the adit level, in the end south of cross-cut, the lode has divided into branches, and not rich. During the present month we shall open a new stopes in the bottom of this level, where we estimate the lode will give 6 tons per fathom, worth 15 dwts. per ton. The end south of cross-cut, on No. 2 lode, is poor at present. The 23 fm. level end south yields 3 tons per fathom, worth 12 dwts. per ton, and bids fair for an increase of ore. The stopes in the bottom, south of whelm-shaft, yield 4 tons per fathom, worth 14 oz. of gold per ton. The stopes in the bottom of this level, south of whelm, yield 10 tons per fathom, worth 1 oz. of gold per ton, and the stopes in the bottom, worth 15 dwts. per ton. The stopes in the bottom 5 tons, worth 17 dwts. per ton; and the stopes in the back 6 tons, worth 9 dwts. per ton. The end of the 33 south is not yielding at the present time a sufficient quantity of ore to value, but letting out plenty of water. The stopes in the back yield 6 tons per fathom, worth 17 dwts. per ton. The winze in the bottom of this level yields 4 tons per fathom, worth 1½ oz. per ton. The 46 fm. level end south yields 4 tons per fm., worth 9 dwts. per ton. The stopes in the bottom yield 6 tons, worth 1 oz. of gold per ton.—Pescheira: The lode in the end south at the 16 yields 3 tons per fm., worth 2 dwts. per ton. The stopes in the back yield 6 tons, at 14 dwts. per ton. The end of the 33 south is poor. The stopes in the bottom, on No. 5 lode, yields 4 tons, worth 15 dwts. per ton. At the 33 we are driving a cross-cut west from the eastern part of No. 2 lode to intersect the western, or principal part of the lode; we expect to reach it in 1 metre more driving. The end north in the 46 yields 4 tons per fathom, worth 15 dwts. per ton. The stopes in the bottom of the 70 yield 10 tons per fathom, worth 1½ oz. per ton; and the stopes in the bottom of the 75 yield 4 tons, worth 1½ oz. of gold per ton. We have not made such progress in the past month in clearing the 46 as anticipated, owing to the whelm being so much engaged in hoisting from the levels above; we have, however, cleared and laid a new tramroad 44 metres from the whelm-shaft."

**VAL TOPPA.** The end driving south in No. 1 level yields 7 tons per fathom, worth 8 dwts. per ton. The lode in the end driving north is somewhat disordered by a cross cleavage. In No. 2 level the lode in the end south produces 6 tons per fathom, worth ½ oz. per ton. No. 1 stopes, in back of this level, yield 10 tons per fathom, worth 15 dwts. per ton. No. 2 stopes yield 10 tons per fm., worth 1½ oz. per ton. No. 3 stopes produce 4 tons per fathom, worth ½ oz. per fm., No. 4 stopes yield 8 tons per fathom, worth 15 dwts. per ton. We have suspended the first cross-cut, in the adit level, and have commenced to drive south on the last lode cut in the cross-cut.—No. 3 Level: The end driving south on the side lode is poor at present. The winze sinking from this level is producing 7 tons per fathom, worth 1 oz. of gold per ton. The rise yields 8 tons per fathom, worth 1 oz. per ton. The stopes south of the rise produce 5 tons per fathom, worth 15 dwts. per ton. No change in either of the cross-cuts driving

from the different levels. The wire-rope tramways are being pushed forward by the contractor with a good force of men. The Val Toppa line is only waiting the arrival of the turbine-shipped last month from England to be put into a working state. The Pestarena line is being advanced rapidly, and by the end of May will probably be completed. The deep snow at Pestarena severely checked the rope-road work which was erected last year, and in one case only has it given way. The contractor is now strengthening that part in a manner which it is hoped will prevent future accidents. The surface work in connection with the hoisting and discharging terminal is in a forward state. At Pestarena the new water channel is well advanced, and the pipes for increasing the pressure on the turbines are for the most part on the ground. At Val Toppa considerable improvements are being carried out in the mode of delivering the ore from the mine to the ropes, and receptacles for 1000 tons of ore are being constructed at Piedimulera at the reduction works, so that in case of an accident to the ropes, or other causes, a good supply of ore may always be at hand for the mills. The stamping machinery, water-wheel, &c., are in course of construction. The German jigging machinery, driven by water-wheel, is now in operation, and works very satisfactorily for the concentration of the ore. In the early part of April a strike took place amongst the miners and workpeople at Val Toppa, which lasted a few days only. The men have since returned to work on the conditions offered by the company—the substitution of piecework for day-work, and day-work has been almost entirely abolished, to the advantage of all parties. There have not been any disturbances at other mines belonging to the company.

**EXCHEQUER.**—Capt. Chalmers, Bullions, Alpine County, California, April 1: "During the month we sank the winze 20 ft., ran 35 ft. of drifts from the 40, raised 10 ft. between the 30 and 40, and took out a considerable quantity of good-looking ore, part of which has been got up as far as Silver Mountain for shipment No. 2. The air-shaft was raised 35½ ft., cross drifts made for prospecting purposes 15 ft., and the ledge here looks as if it would turn out pay soon. As I intended in my last, it became necessary to enlarge the shaft down before raising further, on account of the want of air; the men would come down with their eyes literally starting from their sockets, and the perspiration pouring from them; of this 8 ft. has been accomplished, and substantially timbered. Instead of going down to the 100, as originally intended, knowing you desire to have periodical shipments, if possible, I have been drifting from the 40, and raising between that and the 30, in order to get 10 tons of ore to Reno mill before the close of April. Under 10 tons they charge \$35 per ton for reduction, above that only \$30. On Thursday morning (having had a telegram from the Reno mill) Mr. Chalmers and I took the stage, and arrived at Reno at midnight. After a careful examination of the mill, we saw the ore weighed, and watched its progress through all the stages of drying, mixing with salt, crushing, roasting, and chloridizing, amalgamation, retorting, and smelting, and much pleasure in sending you bar No. 1, value \$289.90. Although the ore did not work so high as we anticipated, I think we were well repaid, seeing that all the sorting it had was what it got in the drifts, where men cannot judge it so well as when carefully washed and picked on a spalling floor above. Deficiency of light, and its deceptive effect on the look of ore, and the muddy condition of the rock, are the obstacles to a close separation; washing off the mud is not practicable in the mine. In order to effect a separation the vein rock must be broken; as this involves an additional hand, I did not, in the face of your restrictions, consider myself justified in increasing the force, even for this purpose, and thought it well as to rate to the first batch, as it came from the winze without sorting on surface. The next batch, although it will, no doubt, disturb the working of the present shifts, I am having spalled on top, and more carefully sorted and dried. You will see from the accompanying mill returns that the assay value of the 2½ tons was—gold, \$36.88; silver, \$102.22; total, \$139.10 (30*l.*). Six assays were made, Mr. Chalmers checked them, and all agreed; hence, without deductions, and supposing our own mill capable of working up to the assay value (which, however, no prospector yet discovered ever does), our bar would have been worth \$287.76 (72*l.* 10*s.* 6*d.*), or at 95 per cent., up to which I think it possible to work by the Stateside process, it would have been worth \$330—\$132 per ton, a high average return, when you bear in mind that the Great Comstock average is under \$40. I do not now propose to give you a full description of the Reno mill, but reserve that for a future occasion; suffice it to say, it appears to do effectually all it claims, and will take a profit out of \$12 ore. I must not omit to mention that we received from Mr. Dunne, the manager, every attention and courtesy, and no pains were spared by either himself or Mr. Brown, the assayer, to "post" us on everything connected with it. From information there received I shall be able shortly to give you an estimate of the expense of such a mill (20 stamps), cost of reduction of ore, and all that is necessary to enable you to judge of its efficiency and economy. You will also be glad to hear that Mr. Brown stated that no bullion of the same fineness had ever gone through their mill, the average (counting the standard at 1000) being under 800—Exchequer, 901; and the foreman remarked to Mr. Chalmers that if we could supply the mill entirely for a week or so he believed the bullion would be close to 1000 (1000 is the standard), our ore followed an inferior grade in the same stamps, it could not but be mixed up with some portion of its impurity, and its fineness thereby deteriorated. If this shipment is to be continued, and the work is to be done in a business-like way, an ore-house and spalling-floors are necessary; meantime an additional man to spall and sort is almost indispensable, for it will not pay to carry dirt and moisture to Reno. I propose, therefore, that as soon as sawn lumber can be got a tank be made some 10 by 12 ft., on top of which at a slight angle I would place a gridiron or screen, bars about 1½ in. apart. A few boards temporarily nailed up at the foot of the gridiron would in the meantime serve as spalling-floors. From the 10 by 12 ft. box I should fix a few sluice boxes, leading to a waste tank or reservoir for tailings. On the 10 by 12 ft. screen the ore would be dumped from the car, the fine will go through the gratings, and the coarse roll below on the spalling-floor, where it will be broken up (spalled), and sorted into first, second, and third classes; the first only going to Reno, the second and third waiting our own mill, where it will pay. At the mouth of the tunnel I should excavate a tank to hold a considerable quantity of water, having a gate to open and shut; into this tank will go all the water from the tunnel, and from it by means of a sluice into the 10 by 12 ft. box, above referred to. This will wash away the dirt from that part of the ore which fell through the bars from the car, and leave the balance pretty highly concentrated both there and in the sluice-boxes from that to the tailing tank without much cost, except occasional stirring and jiggling. The only obstacle to all that is the difficulty of getting lumber and the increased monthly expense, but if you wish good results you must not grumble at this. I am unwilling to commit myself to an expression of opinion with regard to the batch I am to send to Reno, but I think I may do so with confidence that I shall be much disappointed if No. 2 bar does not agreeably surprise you. If we are to make our first level at the 50 we can probably employ four additional men sinking in the winze to the 100, while the other shift is stopping from the 50, and it would pay to do so. The more a mine is opened the more ore you can take out, and, therefore, the more chance of speedy returns. If I can get out 5 tons of \$100 ore a day at a profit of \$50 per ton I gain \$250 (52*l.* 10*s.*), but if by opening up additional levels I can make my daily yield 20 tons, my profit is \$1000 (210*l.* sterling) per day. I should like to say a word with regard to your instructions, I should be glad to know whether if I find myself able to continue my shipments to Reno I am to do so, and if so, whether I am to sell the bullion at Reno, or forward to you by Wells, Fargo, and Co.'s express C.O.D. You will be able to judge of the expense when you pay Wells and Fargo their charges for No. 1 bar. I do not know what may be thought of \$140 ore in London, but here, and in most mining counties, it is considered a high average from, comparatively speaking, unassorted ore. In 1864 \$40 ore was, I understand, discarded by Comstock operators as too poor, whereas a mill owner would be glad to buy a large quantity of \$40 ore, so Mr. Raymond says in his report to the Treasury of the United States on the mines of the West, Jan. 18, 1869."

**Capt. Chalmers, April 12:** I beg to state for the information of the board that it is impossible to furnish an average assay of all the ore taken from the mine since commencing operations without having the whole crushed, and a sample taken from the batteries every five minutes. In the usual way. If, however, we are to judge from the result of the working of the 2½ tons sent to Reno, of which you have full particulars in my monthly report, the average value of the ore at \$100 to \$140 per ton. Mr. Chalmers' assays range all the way from \$20 to \$1750 per ton, and the last he made gave—gold, \$20.47; silver, 1739.89; total, \$1750.56 per ton (367*l.* sterling), but this quality has only begun to make its appearance in very small streaks, which, however, may widen as we get down. Without any facilities for weighing or measuring at the mine, I should say roughly we have taken out of all grades over 6 tons last Saturday. As we have now recommenced sinking the winze to the 50 we shall only have what may come out during that operation until our level are opened north and south from that point. As to the continuance of the same supply it is impossible to say, but I look forward to an improvement with depth, and have no reason to apprehend any difficulty with water for some time. Anticipating your wishes as to the weekly progress, I have regularly reported, of dates the 25th, 14th, 21st, 28th ult., and 8th inst., and these letters contain all the information asked for under this head, except that as soon as the air-shaft is through I shall carry the tunnel to the extreme of the ground north, cross-cutting the ledge at intervals after passing C, and take out the ore by raising above that level, while what is below will be taken out by raising from the 50 ft. level in the winze. I need scarcely explain to you what must be self-evident, that if we are to take out ore by raising—i.e., by picking it down from above when its own specific gravity will bring it to the adit level—than by sinking, where every pound must be hoisted. As requested, a report will be dispatched on June 1. During the week ending Saturday, the 9th inst., the enlargement of the air-shaft downwards was effected to the extent of 12 ft., and about 28 000 lbs. of ore extracted from the winze south drift, between the 30 and 40.

[For remainder of Foreign Mines see to-day's Journal.]

**PUMPS AND BLAST-ENGINES.**—Mr. R. R. GIBBS, of Liverpool, has patented an invention, which consists in the employment in pumps, vacuum pumps, and blast-engines of a sliding-valve or valves worked by the same mechanical power or force as the pump itself, instead of loose valves. The second part consists in regulating the quantity of water or air ejected; a sliding link is united to the piston or plunger, the other end of which is in connection with a lever capable of receiving, when required, a to and fro motion, and provided with a rod taking into the teeth of a quadrant for retarding the lever when any particular position when required. The third part consists in providing a ring, in combination with a casing, to shield it from dust and slight, and at the same time made in one casting with the rest of the gland.

**PREVENTION OF BOILER INCrustATION.**—A very simple mode of preventing boiler incrustation is in general use at the Harrogate Gas Works. The engine has worked day and night since 1854 almost without interruption, and the formation of calcareous deposits has been entirely prevented by the use of crude pyrophosphoric acid, combined with tar; it is either introduced into the boiler or mixed with the feed water. Since this mixture has been in use they have never had a stoppage through incrustation, and have never had to use a hammer to remove scale. Each year, during the summer, when less steam is required, the boiler is opened, and perhaps a couple of handfulls of loose sediment taken from the bottom. The quantity employed is very small—just enough to redden it thus paper; consequently the iron is not attacked, as is often the case from the fact that the boiler has been but twice under repair.—*Scientific American.*

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